```
# import libraries

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

```
# load dataset
from google.colab import drive
drive.mount('/content/drive')
file_path = ('/content/drive/MyDrive/almabetter_project/Superstore Marketing Data.xlsx')
df = pd.read_excel(file_path)
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

Task 1 - Basic CleanUp

1.Clean and preprocess the dataset (handling missing values, data types, etc.).

2.Analyze the distribution of customer demographics (age, education, marital status) using descriptive statistics and visualizations.

```
# Clean and preprocess the dataset (handling missing values, data types, etc.)

print(df.head())
print('\n\n')

print(df.info())
print('\n\n')

print ('check how many rows are null')
print(df.isnull().sum())

print('\n\n')
print('check how many rows are duplicate')
print(df.duplicated().sum())
```

```
      Id  Year_Birth   Education Marital_Status   Income  Kidhome  Teenhome  \
0   1826        1970  Graduation       Divorced  84835.0        0         0
1      1        1961  Graduation         Single  57091.0        0         0
2  10476        1958  Graduation        Married  67267.0        0         1
3   1386        1967  Graduation       Together  32474.0        1         1
4   5371        1989  Graduation         Single  21474.0        1         0

  Dt_Customer  Recency  MntWines  ...  MntFishProducts  MntSweetProducts  \
0   6/16/2014        0       189  ...              111               189
1   6/15/2014        0       464  ...                7                 0
2   5/13/2014        0       134  ...               15                 2
3    ########        0        10  ...                0                 0
4    ########        0         6  ...               11                 0

   MntGoldProds  NumDealsPurchases  NumWebPurchases  NumCatalogPurchases  \
0           218                  1                4                    4
1            37                  1                7                    3
2            30                  1                3                    2
3             0                  1                1                    0
4            34                  2                3                    1

   NumStorePurchases  NumWebVisitsMonth  Response  Complain
0                  6                  1         1         0
1                  7                  5         1         0
2                  5                  2         0         0
3                  2                  7         0         0
4                  2                  7         1         0

[5 rows x 22 columns]



<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2240 entries, 0 to 2239
Data columns (total 22 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   Id                   2240 non-null   int64
 1   Year_Birth           2240 non-null   int64
 2   Education            2240 non-null   object
 3   Marital_Status       2240 non-null   object
 4   Income               2216 non-null   float64
 5   Kidhome              2240 non-null   int64
 6   Teenhome             2240 non-null   int64
 7   Dt_Customer          2240 non-null   object
 8   Recency              2240 non-null   int64
 9   MntWines             2240 non-null   int64
 10  MntFruits            2240 non-null   int64
 11  MntMeatProducts      2240 non-null   int64
 12  MntFishProducts      2240 non-null   int64
 13  MntSweetProducts     2240 non-null   int64
 14  MntGoldProds         2240 non-null   int64
 15  NumDealsPurchases    2240 non-null   int64
 16  NumWebPurchases      2240 non-null   int64
 17  NumCatalogPurchases  2240 non-null   int64
 18  NumStorePurchases    2240 non-null   int64
 19  NumWebVisitsMonth    2240 non-null   int64
 20  Response             2240 non-null   int64
```

```
df['Income'] = df['Income'].fillna(df['Income'].mean())
print(df['Income'].isnull().sum())

df['Dt_Customer'] = pd.to_datetime(df['Dt_Customer'], errors='coerce')
most_common_date = df['Dt_Customer'].mode()[0]
df['Dt_Customer'].fillna(most_common_date)
print(df['Dt_Customer'].isnull().sum())
```

```
0
916
```

```
# Print data types
print(df.dtypes)
```

```
Id                               int64
Year_Birth                       int64
Education                       object
Marital_Status                  object
Income                         float64
Kidhome                          int64
Teenhome                         int64
Dt_Customer             datetime64[ns]
Recency                          int64
MntWines                         int64
MntFruits                        int64
MntMeatProducts                  int64
MntFishProducts                  int64
MntSweetProducts                 int64
MntGoldProds                     int64
NumDealsPurchases                int64
NumWebPurchases                  int64
NumCatalogPurchases              int64
NumStorePurchases                int64
NumWebVisitsMonth                int64
Response                         int64
Complain                         int64
dtype: object
```

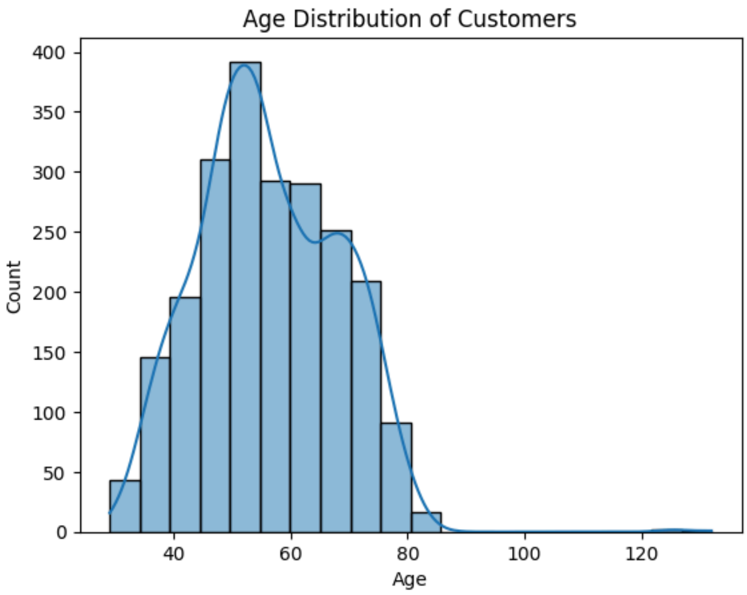
```
df['Education'] = df['Education'].astype('category')
df['Marital_Status'] = df['Marital_Status'].astype('category')

print(df[['Education', 'Marital_Status']].dtypes)
print(df[['Education', 'Marital_Status']].head())
```

```
Education         category
Marital_Status    category
dtype: object
    Education Marital_Status
0  Graduation       Divorced
1  Graduation         Single
2  Graduation        Married
3  Graduation       Together
4  Graduation         Single
```

```
# Analyze the distribution of customer demographics (age, education, marital status) using descriptive statistics and visualizations.

# Descriptive statistics for numerical demographic columns
df['Age'] = 2025 - df['Year_Birth']
demographic_numerical = ['Age', 'Income', 'Kidhome', 'Teenhome']
print("📊 Numerical Demographics Summary:")
print(df[demographic_numerical].describe())


# Value counts for categorical demographic columns
demographic_categorical = ['Education', 'Marital_Status', 'Response']
for col in demographic_categorical:
    print(f"\n🔶 Value counts for {col}:")
    print(df[col].value_counts(normalize=True) * 100)  # percentage distribution
```

```
📊 Numerical Demographics Summary:
               Age         Income      Kidhome     Teenhome
count  2240.000000    2240.000000  2240.000000  2240.000000
mean     56.194196   52247.251354     0.444196     0.506250
std      11.984069   25037.797168     0.538398     0.544538
min      29.000000    1730.000000     0.000000     0.000000
25%      48.000000   35538.750000     0.000000     0.000000
50%      55.000000   51741.500000     0.000000     0.000000
75%      66.000000   68289.750000     1.000000     1.000000
max     132.000000  666666.000000     2.000000     2.000000

🔶 Value counts for Education:
Education
Graduation    50.312500
PhD           21.696429
Master        16.517857
2n Cycle       9.062500
Basic          2.410714
Name: proportion, dtype: float64

🔶 Value counts for Marital_Status:
Marital_Status
Married     38.571429
Together    25.892857
Single      21.428571
Divorced    10.357143
Widow        3.437500
Alone        0.133929
Absurd       0.089286
YOLO         0.089286
Name: proportion, dtype: float64

🔶 Value counts for Response:
Response
0    85.089286
1    14.910714
Name: proportion, dtype: float64
```

```
import seaborn as sns
import matplotlib.pyplot as plt

# Age distribution
sns.histplot(df['Age'], bins=20, kde=True)
plt.title('Age Distribution of Customers')
plt.xlabel('Age')
plt.ylabel('Count')
plt.show()
```

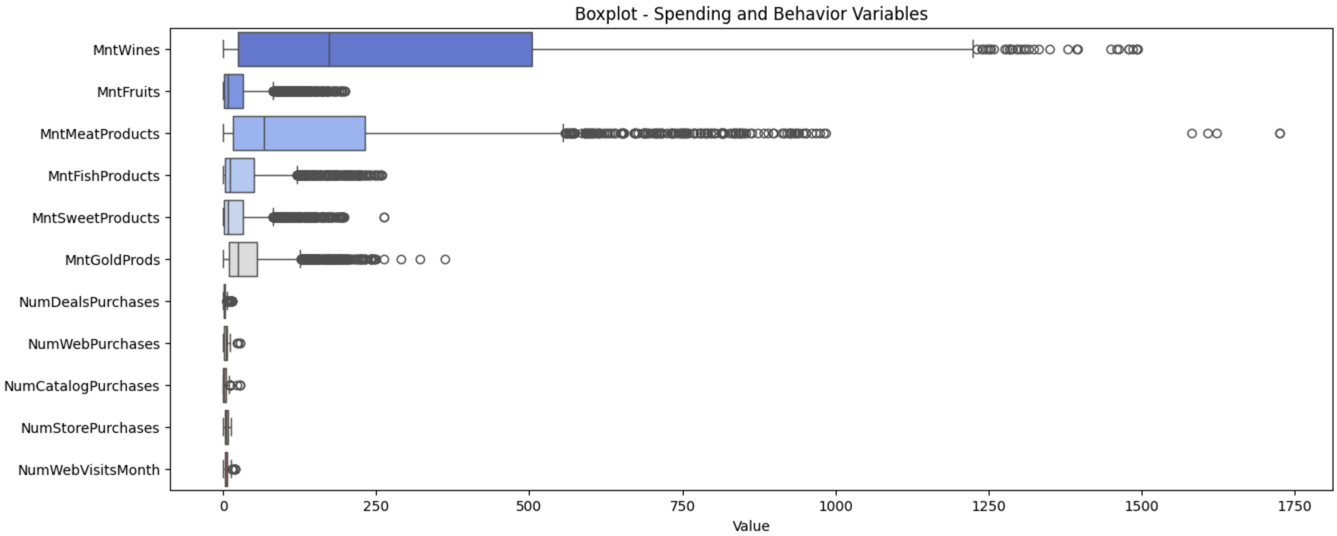


Task 2 - Descriptive Statistics

```
# Selecting relevant numerical columns
cols = ['MntWines', 'MntFruits', 'MntMeatProducts', 'MntFishProducts',
        'MntSweetProducts', 'MntGoldProds', 'NumDealsPurchases',
        'NumWebPurchases', 'NumCatalogPurchases', 'NumStorePurchases',
        'NumWebVisitsMonth']

# Descriptive statistics table
desc_stats = df[cols].agg(['mean', 'median','std', 'var', 'min', 'max', 'skew']).T
desc_stats.columns = ['Mean', 'Median', 'Std Dev', 'Variance', 'Min', 'Max', 'Skewness']
print(desc_stats)


print('\n\n')
# Mode calculation separately
for col in cols:
    print(f"Mode of {col}: {df[col].mode().values}")
```

```
                           Mean  Median     Std Dev       Variance  Min  \
MntWines             303.935714   173.5  336.597393  113297.804709  0.0
MntFruits             26.302232     8.0   39.773434    1581.926033  0.0
MntMeatProducts      166.950000    67.0  225.715373   50947.429388  0.0
MntFishProducts       37.525446    12.0   54.628979    2984.325391  0.0
MntSweetProducts      27.062946     8.0   41.280498    1704.079555  0.0
MntGoldProds          44.021875    24.0   52.167439    2721.441683  0.0
NumDealsPurchases      2.325000     2.0    1.932238       3.733542  0.0
NumWebPurchases        4.084821     4.0    2.778714       7.721252  0.0
NumCatalogPurchases    2.662054     2.0    2.923101       8.544517  0.0
NumStorePurchases      5.790179     5.0    3.250958      10.568729  0.0
NumWebVisitsMonth      5.316518     6.0    2.426645       5.888606  0.0

                        Max  Skewness
MntWines             1493.0  1.175771
MntFruits             199.0  2.102063
MntMeatProducts      1725.0  2.083233
MntFishProducts       259.0  1.919769
MntSweetProducts      263.0  2.136081
MntGoldProds          362.0  1.886106
NumDealsPurchases      15.0  2.418569
NumWebPurchases        27.0  1.382794
NumCatalogPurchases    28.0  1.880989
NumStorePurchases      13.0  0.702237
NumWebVisitsMonth      20.0  0.207926



Mode of MntWines: [2]
Mode of MntFruits: [0]
Mode of MntMeatProducts: [7]
Mode of MntFishProducts: [0]
Mode of MntSweetProducts: [0]
Mode of MntGoldProds: [1]
Mode of NumDealsPurchases: [1]
Mode of NumWebPurchases: [2]
Mode of NumCatalogPurchases: [0]
Mode of NumStorePurchases: [3]
Mode of NumWebVisitsMonth: [7]
```

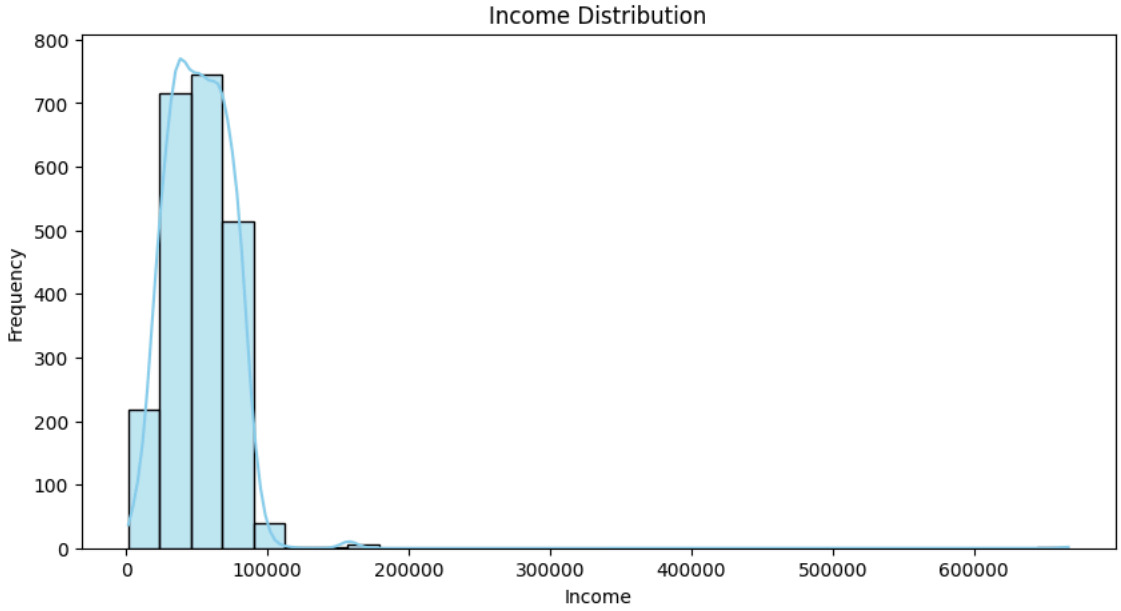
```
import matplotlib.pyplot as plt
import seaborn as sns

plt.figure(figsize=(15, 6))
sns.boxplot(data=df[cols], orient='h', palette="coolwarm")
plt.title("Boxplot - Spending and Behavior Variables")
plt.xlabel("Value")
plt.show()
```



```
Start coding or generate with AI.
```

Task 3 - Probability Distributions

```
# Step 1: Choose Suitable Variables

#1.Continuous (Normal)  Income, MntWines, MntMeatProducts, MntGoldProds, Recency
#2.Discrete (Binomial/Poisson)  NumDealsPurchases, NumWebPurchases, NumCatalogPurchases, NumStorePurchases

# Step 2: Check for Normal Distribution (Histogram + KDE)
import seaborn as sns
import matplotlib.pyplot as plt

# Plotting histogram + KDE for continuous variable
plt.figure(figsize=(10,5))
sns.histplot(df['Income'].dropna(), kde=True, bins=30, color='skyblue')
plt.title("Income Distribution")
plt.xlabel("Income")
plt.ylabel("Frequency")
plt.show()
```

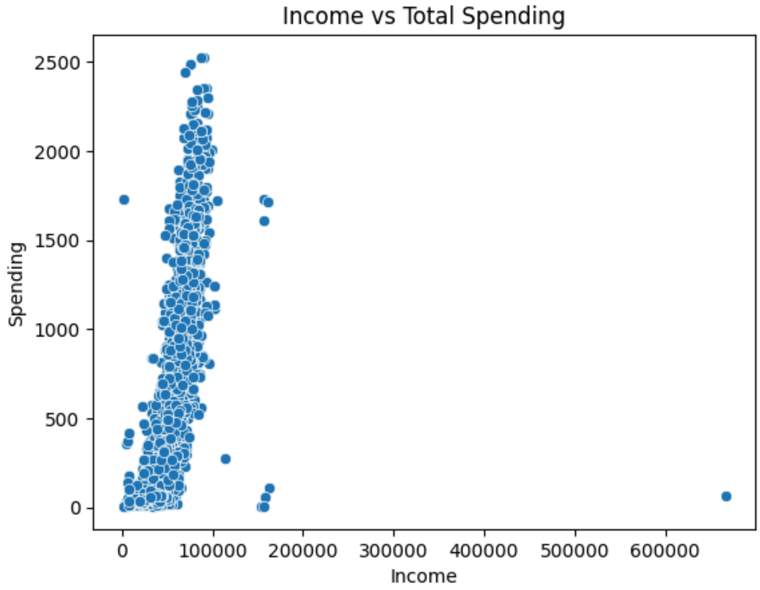


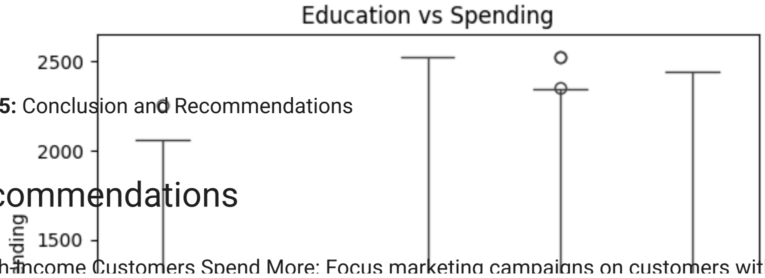
```
 # Step 3: Normality Test (Shapiro-Wilk or D’Agostino)

from scipy.stats import shapiro

# Shapiro-Wilk test (p > 0.05 → likely normal)
stat, p = shapiro(df['Income'].dropna())
print(f"Shapiro-Wilk Test for Income → p-value: {p}")

print('\n')



# step4 : Probability Calculation (Normal)
from scipy.stats import norm

# Mean and Std Dev
mu = df['Income'].mean()
sigma = df['Income'].std()

# P(Income > 80,000)
p_income_gt_80000 = 1 - norm.cdf(80000, mu, sigma)
print(f"P(Income > 80000): {p_income_gt_80000:.4f}")

print('\n')



# Step 5: Discrete Variable Example (Poisson for Web Purchases)
from scipy.stats import poisson

# Assume average rate (lambda)
lam = df['NumWebPurchases'].mean()

# P(X = 5 purchases)
p_5 = poisson.pmf(5, lam)
print(f"P(Exactly 5 Web Purchases): {p_5:.4f}")
print('\n')


# Step 6: Expected Value
print("Expected value of Wine Purchase:", df['MntWines'].mean())
```

```
Shapiro-Wilk Test for Income → p-value: 5.625049146757823e-48


P(Income > 80000): 0.1338


P(Exactly 5 Web Purchases): 0.1595


Expected value of Wine Purchase: 303.9357142857143
```

Task 4: Insights and Customer Segmentation 📈

```
# Step 1: Spending Behavior vs Demographics (Correlation)
# Add total spending column
df['Total_Spending'] = df[['MntWines', 'MntFruits', 'MntMeatProducts',
                           'MntFishProducts', 'MntSweetProducts', 'MntGoldProds']].sum(axis=1)


# Plot: Income vs Spending
sns.scatterplot(x='Income', y='Total_Spending', data=df)
plt.title("Income vs Total Spending")
plt.xlabel("Income")
plt.ylabel("Spending")
plt.show()


#Step 2: Spending by Education
sns.boxplot(x='Education', y='Total_Spending', data=df)
plt.title("Education vs Spending")
plt.xticks(rotation=45)
plt.show()



#Step 3: Spending by Marital Status
sns.boxplot(x='Marital_Status', y='Total_Spending', data=df)
plt.title("Marital Status vs Spending")
plt.xticks(rotation=45)
plt.show()
```





Task 5: Conclusion and Recommendations

Recommendations

1.High-income Customers Spend More: Focus marketing campaigns on customers with income above average (>60,000).